

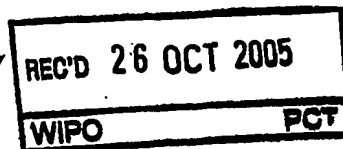
## PATENT COOPERATION TREATY


## PCT

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference 53389-210		<b>FOR FURTHER ACTION</b>		See Form PCT/PEA/416
International application No. PCT/CA2004/000976		International filing date (day/month/year) 02.07.2004		Priority date (day/month/year) 02.07.2003
International Patent Classification (IPC) or national classification and IPC H01B1/20, H01M8/02				
Applicant E.I. DU PONT CANADA COMPANY				
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 4 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 5 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input checked="" type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand  02.02.2005		Date of completion of this report  25.10.2005		
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer  Marsitzky, D  Telephone No. +49 89 2399-7275		



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**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/CA2004/000976

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**Box No. I Basis of the report**

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

**Description, Pages**

1-14 as originally filed

**Claims, Numbers**

1-29 received on 18.04.2005 with letter of 18.04.2005

**Drawings, Figures**

1, 2 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/CA2004/000976

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	7-29
	No: Claims	1-6
Inventive step (IS)	Yes: Claims	7-29
	No: Claims	1-6
Industrial applicability (IA)	Yes: Claims	1-29
	No: Claims	

2. Citations and explanations (Rule 70.7):

**see separate sheet**

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**Box No. VII Certain defects in the international application**

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The following defects in the form or contents of the international application have been noted:

**see separate sheet**

Reference is made to the following documents:

- D1:** US-A-6 059 997 (HALL TOM J) 9 May 2000 (2000-05-09)  
**D2:** PATENT ABSTRACTS OF JAPAN vol. 0120, no. 33 (C-472), 30 January 1988  
(1988-01-30) & JP 62 181347 A (NITTO ELECTRIC IND CO LTD), 8 August  
1987 (1987-08-08)  
**D3:** WO 99/60643 A (DOW CHEMICAL CO) 25 November 1999 (1999-11-25)

**1. Article 33 (2) PCT:**

- 1.1 D1 and D2 disclose (see the passages cited in the Search report) an electrically conductive composition (and article) comprising a) a grafted polypropylene and b) conductive fillers. Since the second component of the polymer "blend" of claim 1 is only optional, the subject matter of claims 1-7 is not novel.
- 1.2 Since none of D1-D3 discloses a conductive flow field separator plate including a grafted polyolefin nor a process for the production, the subject matter of claims 8-30 is considered to be novel.

**2. Article 33 (3) PCT:**

D3 is considered to represent the closest prior art since it deals with the same technical area. The difference of present claims 8-30 compared to D3 is the use of a special grafted polyolefin. This difference leads to separator plates with improved processability in combination with excellent conductivity and mechanical properties. The objective technical problem can be formulated as to provide separator plates with improved properties. Since none of D1-D3 gives a hint on how to solve the problem, the subject matter of claims 8-30 is considered to be inventive.

**3. Article 6 PCT:**

The term "about" describing ranges should be deleted in the whole application to render the scope of protection sought for clear !!!

**What is claimed is:**

1. An electrically conductive shaped article comprising from about 10 wt% to about 25 wt% of a polymer resin and from about 75 wt% to about 90 wt% of conductive fillers, wherein the polymer resin is a polymer blend comprising (1) from about 10 to 100 wt%, preferably from about 50 to about 100 wt% of a grafted polyolefin or a blend of grafted polyolefins and (2) from 0 to about 90 wt%, preferably from about 0 to about 50 wt% of at least one other thermoplastic polymer having a melting point below 280 °C.
2. The electrically conductive shaped article of claim 1, wherein the grafted polyolefin is a grafted polypropylene.
3. The electrically conductive shaped article of claim 2, wherein the grafted polypropylene is maleic anhydride grafted polypropylene.
4. The electrically conductive shaped article of claim 1, wherein the grafted polyolefin contains from about 0.05 wt% to about 10 wt%, preferably from about 0.05 to about 5 wt% of ethylenically unsaturated carboxylic acid or its derivatives grafted onto the grafted polyolefin.
5. The electrically conductive shaped article of claim 2, wherein the grafted polypropylene comprises a grafted polypropylene homopolymer, grafted propylene copolymers or mixtures thereof.
6. The electrically conductive shaped article of any one of claims 1-5, wherein the conductive fillers are selected from carbon fillers, graphite fillers, metallic fillers, inherent conductive polymers and mixtures thereof, and the conductive fillers are in the shape of spherical or irregular particles, fibers, powders, flakes or a mixture thereof.
7. A conductive flow field separator plate for use in a polymer electrolyte membrane fuel cell comprising a polymer resin and conductive fillers, wherein the polymer resin is a polymer blend comprising (1) from about 10 to 100 wt%, preferably from about 50 to about 100 wt% of a grafted polyolefin or a blend of grafted polyolefins and (2) from 0 to about 90 wt%, preferably from about 0 to about 50

wt% of at least one other thermoplastic polymer having a melting point below 280 °C.

8. The conductive flow field separator plate of claim 7, wherein the grafted polyolefin contains from about 0.05 wt% to about 10 wt%, preferably from about 0.05 to about 5 wt% of ethylenically unsaturated carboxylic acid or its derivatives grafted onto the grafted polyolefin.
9. The conductive flow field separator plate of claim 7 or 8, wherein the grafted polyolefin is maleic anhydride grafted polypropylene.
10. The conductive flow field separator plate of any one of claims 7-9, comprising from about 10 wt% to about 50 wt%, preferably from about 15 wt% to about 25 wt%, of the polymer resin and from about 50 wt% to about 90 wt%, preferably from about 75 wt% to about 85 wt%, of the conductive fillers.
11. The conductive flow field separator plate of claim 9, wherein the maleic anhydride grafted polypropylene has a resin base of polypropylene homopolymer, a copolymer of propylene with other olefinic monomers or a mixture thereof.
12. The conductive flow field separator plate of any one of claims 7-11, wherein the conductive fillers are selected from carbon fillers, graphite fillers, metallic fillers, inherent conductive polymers and mixtures thereof, and the conductive fillers are in the shape of spherical or irregular particles, fibers, powders, flakes or a mixture thereof.
13. The conductive flow field separator plate of claim 9, having a volume resistivity of not more than about 0.1 ohm.cm and a flexural strength of not less than about 3000 Psi.
14. A method of making a conductive flow field separator plate comprising the steps of:
  - (a) mixing a polymer resin with conductive fillers to form a conductive blend, wherein the polymer resin is a polymer blend comprising (1) from about 10 to 100 wt%, preferably from about 50 to about 100 wt% of a grafted polyolefin or a blend of grafted polyolefins and (2) from 0 to about 90

wt%, preferably from about 0 to about 50 wt% of at least one other thermoplastic polymer having a melting point below 280 °C; and

(b) molding the conductive blend to form the conductive flow field separator plate.

15. The method of claim 14, wherein the grafted polyolefin comprises from about 0.05 wt% to about 10 wt%, preferably from about 0.05 to about 5 wt% of ethylenically unsaturated carboxylic acid or its derivatives grafted onto the grafted polyolefin.
16. The method of claim 14 or 15, wherein the grafted polyolefin is maleic anhydride grafted polypropylene.
17. The method of any one of claims 14-16, comprising from about 10 wt% to about 50 wt%, preferably from about 15 wt% to about 25 wt%, of the polymer resin and from about 50 wt% to about 90 wt%, preferably from about 75 wt% to about 85 wt%, of the conductive fillers.
18. The method of claim 16, wherein the grafted polyolefin has a resin base of a polypropylene homopolymer, a copolymer of propylene with other olefinic monomers or a mixture thereof.
19. The method of any one of claims 14-18, wherein the conductive fillers are selected from carbon fillers, graphite fillers, metallic fillers, inherent conductive polymers and mixtures thereof, and the conductive fillers are in the shape of spherical or irregular particles, fibers, powders, flakes or a mixture thereof.
20. The method of any one of claims 14-19, wherein the separator plate has a volume resistivity of not more than about 0.1 ohm.cm and a flexural strength of not less than about 3000 Psi.
21. A process for making a conductive flow field separator plate for use in polymer electrolyte membrane fuel cells comprising the steps of:
  - (a) feeding a mixture of a polymer resin and conductive fillers into an injection molding machine, wherein the polymer resin is a polymer blend comprising (1) from about 10 to 100 wt%, preferably from about 50 to

about 100 wt% of a grafted polyolefin or a blend of grafted polyolefins and (2) from 0 to about 90 wt%, preferably from about 0 to about 50 wt% of at least one other thermoplastic polymer having a melting point below 280 °C,

- (b) plasticising the mixture at a temperature above the melting point of the polymer resin to form a melt,
  - (c) injecting the melt into a mold,
  - (d) allowing the melt to cure in the mold to form the conductive flow field separator plate, and
  - (e) removing the conductive flow field separator plate from the mold.
22. The process of claim 21, wherein in step (c), the mold is closed.
23. The process of claim 21, wherein in step (c), the mold is partially opened, and comprising the further step of closing the mold completely and then compressing the melt.
24. The process of any one of claims 21-23, wherein the grafted polyolefin comprises from about 0.05 wt% to about 10 wt%, preferably from about 0.05 to about 5 wt% of ethylenically unsaturated carboxylic acid or its derivatives grafted onto the polyolefin.
25. The process of any one of claims 21-24, wherein the grafted polyolefin is maleic anhydride grafted polypropylene.
26. The process of any one of claims 21-25, wherein the blend comprises from about 10 wt% to about 50 wt%, preferably from about 15 wt% to about 25 wt%, of the polymer resin and from about 50 wt% to about 90 wt%, preferably from about 75 wt% to about 85 wt%, of the conductive fillers.
27. The process of claim 25, wherein the maleic anhydride grafted polypropylene has a resin base of a polypropylene homopolymer, a copolymer of propylene with other olefinic monomers or a mixture thereof.
28. The process of any one of claims 21-27, wherein the conductive fillers are



selected from carbon fillers, graphite fillers, metallic fillers, inherent conductive polymers and mixtures thereof, and the conductive fillers are in the shape of spherical or irregular particles, fibers, powders, flakes or a mixture thereof.

29. The process of any one of claims 21-28, wherein the separator plate has a volume resistivity of not more than about 0.1 ohm.cm and a flexural strength of not less than about 3000 Psi.

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